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Sunk costs of exports

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Abstract

Using a very large panel dataset of Italian manufacturing firms, we test an empirical model of foreign markets participation with sunk costs. The period of analysis (1982-1999) is exceptionally informative: the large fluctuations in the lira exchange rate determined substantial flows of firms in and out of foreign markets. We find that sunk costs of exporting are very important: past experience in foreign markets increases the probability of exporting by about 70 percentage points. Although the assets entailing such costs depreciate quite slowly, new exporters have to acquire them very soon after entry. Altogether, these results suggest that the break in the Italian aggregate export supply function caused by the depreciation of the 1990s can be considerable and long-lasting. We then relate sunk costs to firm size and find that they are an important barrier to export, especially for the myriad of Italian small and medium firms. Finally, we provide some new evidence that sunk costs are indeed related to the need to collect information on foreign market/country characteristics.

JEL classification: F10, L10, L60, C25.

Keywords: exports, sunk costs, firm size, information, binary choice models.

Contents

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1. Introduction[1]

Empirical work and anecdotal evidence on trade flows suggest various kinds of asymmetry in the response of exports and imports to exchange rate fluctuations. Comparable exchange rate variations may produce different effects in different countries; differences can also emerge in a given country at different dates. Sometimes, the consequences of large depreciations (or, equivalently, appreciations) may be less evident than those of smaller ones. Again, while large increases in exports follow a depreciation, no similar reductions occur when the exchange rate goes back to its pre depreciation level.

As pointed out by a series of theoretical papers in the late 1980s (Baldwin, 1988 and 1989; Baldwin and Krugman, 1989; Dixit, 1989a; Krugman, 1989), sunk costs of exporting may help explain these puzzles. A firm paying sunk costs to enter foreign markets is indeed more reluctant to abandon them. As a result, firms differing only in their exporting status may make different export participation decisions. By aggregation, the effects of a given exchange rate fluctuation differ across time and across countries simply because the type and the number of incumbent exporters are different. Also hysteresis in trade flows may emerge: temporary shocks determining a massive entry of firms in foreign markets can have permanent effects since firms, after paying sunk costs, find it convenient to stay in the market even when the shock ends.

Recently, a few papers have tested the existence of sunk costs of exporting using firm-level data. The seminal paper is by Roberts and Tybout (1997) who derive and estimate a model of a firm's decision to export. According to the theoretical model, if sunk costs matter, there is a range of values over foreign market profitability where exporters keep exporting while non-exporters do not start to do so; in other words, there is an inaction band, where each firm persists in its past behavior. Moreover, the size of the inaction band increases with the amount of sunk costs. Using a sample of 650 Colombian plants for the period 1981-89,

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Roberts and Tybout (1997) exploit these features and empirically show that sunk costs matter owing to the relevance of past exporting status for current exporting, i.e., the lagged dependent variable in a Probit model of export participation. Using the same model, though sometimes differently estimated, other scholars find a similar result. Bernard and Wagner (1998) do so in the case of 7,600 German manufacturing plants between 1978 and 1992; Bernard and Jensen (2001) for 13,600 US manufacturing plants in 1984-1992; Campa (2000) for 2,200 Spanish manufacturing firms in 1990-97.

In the last decade, Italy's exports have gone through exceptional swings. According to aggregate trade statistics, export quantities encountered major difficulties before the large lira depreciation in 1992. Afterwards and until the occurrence of the Asian and Russian financial crises in 1997, there was a great resurgence of exports: exporting became a more widespread activity among Italian manufacturing firms, exporters increased their market shares almost everywhere, Italian products entered new markets for the first time - in particular developing countries in South East Asia and Latin America. Subsequently, the crises slowed down Italy's sales abroad and reduced market shares[2].

Exploiting the huge variability in Italian data, the first goal of the paper is to verify whether sunk costs are important for Italian exporters, too. We apply Roberts and Tybout's (1997) model to a very large unbalanced panel of Italian manufacturing firms and find that sunk costs are indeed important: exporting at time $t-1$ increases a firm's probability of exporting at time t by 70 percentage points. Moreover, this effect turns out to be much stronger than that of the full set of the other firm-specific and macroeconomic regressors: moving from the 25th to 75th percentile of the distribution of firms according to the estimated effect of these regressors increases the probability of exporting by less than 10 percentage points.

In line with previous works, we also find that the probability of exporting grows with firm size and productivity, while it decreases with average wages. Firms that are part of industrial groups are more likely to gain access to foreign markets; the same is true for firms located in industrial districts, confirming the important positive role such industrial agglomerations

[2] Undoubtedly, these events can be mapped into the evolution of the exchange rate of the lira. Looking at the trade-weighted nominal effective exchange rate, the lira depreciated by 12.6 percent between August and October 1992. Later on, in 1995, another big drop produced further gains in terms of price competitiveness. After the large appreciation of 1996, the nominal effective exchange rate of the lira was almost stable for a couple of years before following the decline of the euro.

play in Italy. Although we control for a wide set of firm-specific characteristics, sectors still matter: firms operating in sectors where Italy owns a comparative advantage have a higher probability of exporting. Not surprisingly, the probability is greater after depreciations and rises with world demand. Interestingly, domestic demand crowds out export participation to some extent.

This paper represents an innovation with respect to the existing literature in three ways, all aimed at identifying some of the characteristics of the assets whose acquisition entails sunk costs of exporting. First, we carefully investigate timing issues; more precisely, we would like to know how soon these assets must be acquired upon entry and how fast they depreciate after exit[3]. These questions are particularly relevant from an aggregate perspective: if the depreciation rate is small and acquisition is immediate, then the break in the aggregate export function that the 1990s lira turmoil caused in the presence of sunk costs of exporting should be relatively long-lasting. Indeed, we find this is the case for Italy: the differential probability of exporting between firms with and without some past experience drops to zero when the former have been out of foreign markets for at least 6 years; the degree of persistence is identical across incumbent exporters with different experience.

We then move to another feature of sunk costs and ask whether they come in a fixed amount or are proportional to a firm's level of activity. This amounts to looking at the interaction between sunk costs and firm size where the "fixed amount hypothesis" would be confirmed if the degree of persistence decreased with firm size. We show that sunk costs are indeed a strong barrier to exporting for small firms; moreover, this turns out to be true irrespective of sectoral specialization.

Finally, we ask what type of assets firms must acquire before entering foreign markets. In the economic and marketing literature, sunk costs of exporting stem from the need tp collect information about foreign demand, learn about the functioning of the institutional and legal environment in the foreign country, establish a distribution network abroad, and market and promote the product to foreign consumers. Our dataset allows us to focus on the information-related reasons. To this end, we distinguish firms according to their "ability" to collect and process information and find that more able ones display less persistence. This is to say that information collection motives are an active component of sunk costs.

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[3] It should be pointed out that Roberts and Tybout (1997) also consider the depreciation issue.

The rest of the paper is organized as follows. In the next section, we describe the dataset and provide some general descriptive statistics. Section 3 is devoted to the theoretical model, while a detailed description of the estimation strategy is given in section 4. After that, we present the results (section 5) for the base model. We then focus on timing issues (section 6); the interaction between sunk costs, on one side, and size and information, on the other, are in sections 7 and 8 respectively. Some concluding remarks are left to the last section.

2. The data

In the empirical analysis we use a subsample of firms from the Centrale dei Bilanci (Company Accounts Data Service, CADS)[4]. For approximately 30,000 firms per year, CADS collects information on a large number of balance sheet items and some firm characteristics. Data are available from 1982 to 1999. Balance sheets are reclassified in order to reduce the dependence on accounting conventions used by each firm to record income figures and asset values. The focus of CADS on the level of borrowing skews the sample towards larger firms and as a consequence towards northern firms. Moreover, since banks deal mainly with firms that are creditworthy, the sample is also biased toward better than average borrowers.

After ruling out outliers and firms in the first and in the last percentiles computed along various dimensions, we end up with about 270,000 observations, corresponding to 31,000 different firms. The distribution of firms across years is described in the first row of Table 1: the size of our sample grows monotonically from 9,000 firms in 1982 to 18,000 in 1994, after that it drops to 11,000. About 10 per cent of firms (precisely, 3,141 firms) are present for eighteen years; 50 per cent, however, are observed for at least 8 years and a small 5 per cent for only one year. The percentage of exporters fluctuates between 30 and 40 until 1995; after that, thanks to lira depreciations, it jumps to 50-60.

The sample has quite a good coverage: in terms of total value added and employment in Italian manufacturing, our firms cover between 21 and 30 per cent. Importantly, the coverage of total exports, in nominal terms, is also very high (between 13.5 and 26.5 per cent).

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[4] Centrale dei Bilanci is the organization in charge of gathering and managing the data. It was established in the early 1980s jointly by the Bank of Italy, the Italian Banking Association (ABI) and a pool of leading banks with the aim of collecting and sharing information on borrowers. Thus, the sample is not randomly drawn since firms enter only by borrowing from one of the pooled banks.

In Table 2 we provide summary statistics for three different years (1985, 1990, 1995 should capture different cyclical points) for both the full sample and the subsample of exporting firms. Figures on sales, value added and employees indicate that, despite the CADS's bias towards large firms, smaller ones are still fairly well represented. In 1995 firm size ranges from 4 to more than 1,000 employees with a mean of 98 and a median of 58. In terms of sales, value added and number of employees, the maximum, the mean and the median reach a peak in 1995 and a trough in 1990. Average firm age is around 20 years; the oldest firm is 140 years old. The average wage grows over time from 21 to 28 (1995 equivalent) thousand euros. Exporting firms are on average larger, make more sales and have a higher value added. They also pay higher wages.

Table 3 describes firm distribution in terms of sectors and location. Over 70 per cent of our firms are located in the North, less than 10 per cent in the South. The sectoral distribution (Nace Rev.1 classification - two digits) reflects Italian specialization, at least on a quality level. The best represented industry is in fact the one producing industrial and commercial machinery; many firms (about 18 per cent) operate in the so-called traditional sectors (textiles, apparel and leather), while very few belongs to the most innovative "computer and office equipment" and "measuring and controlling instruments". In the case of exporters only, the share of firms operating in the sectors of specialization rises; moreover, they are mainly located in the northern part of Italy.

The propensity to export increases with firm size (Table 4). In 1995 it ranges from 40.4 per cent for firms with less than 50 employees to 75.2 for those with more than 300 employees. Moreover, these figures increase significantly over time[5]. Adding the sectoral dimension, some interesting patterns emerge. Among small firms, the propensity to export is largest in traditional sectors, which is a clear indication on the structure of these industries. On the contrary, firms producing "industrial and commercial machinery" show high relative propensities for each size class.

We now turn to some statistics on flows of firms in and out foreign markets (Table 5). For a given pair of years, the top part of the table is a transition matrix: out of the number of firms exporting at time t it gives the proportion of those exporting and not exporting at time

[5] More precisely, the increases themselves are increasing with firm size. Between 1985 and 1995, the propensity to export grew by 20 per cent for small firms, 23 per cent for medium firms and 37 per cent for large ones.

$t+1$; the same for firms not exporting at time t. The table therefore provides entry and exit rates together with the degree of persistence in and out foreign markets. These flows are then related, in the median part of the table, to the percentage changes in the Italian real effective exchange rate (REER, based on production prices), world export volume (WT) and Italian domestic demand (DD)[6]. The last two rows show the ratio between entering/exiting firms' exports and total exports in the sample.

Not surprisingly, entry (No$_t$ - Yes$_{t+1}$ sequence) and exit (Yes$_t$ - No$_{t+1}$) rates peaked during the period 1992-95. Before the lira depreciation, the difficulties of Italian firms on foreign markets were quite evident: 30 per cent of exporters abandoned foreign markets in 1992; the following year this fraction jumped to 45.4 per cent. Later on, the large depreciation of the lira supported entry: for 1993, 1994, 1995 the entry rates were respectively 17.2, 19.3 and 25.2. In 1994-95 the acceleration of foreign demand provided a further stimulus to new exporters. It is important to note that in these years entering and exiting firms produced one third of total exports: this is to say that these flows of firms had a huge impact on Italian aggregate trade, which is contrary to the findings of Campa (2000) on his sample of Spanish firms[7].

In general, Table 5 shows quite a promising picture. The huge variance in the export participation decision in our data creates an ideal environment for empirical analysis. However, the data also show a large degree of persistence in firm behavior, which, as we previously mentioned, will be the key element for detecting the importance of sunk costs in our theoretical model. However, this is not enough to conclude that sunk costs of exporting matter: many firm and sector-specific factors play an important role in the decision to export; they are also hugely heterogeneous across firms. Therefore a more structural analysis is needed and this is what we address in the next sections.

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[6] All three indices are equal to 100 in 1993. The real effective exchange rate is produced by the Bank of Italy: the methodology is described in Economic Bulletin no. 26. World export volumes are taken from IMF, the domestic demand index from Istat.

[7] Interestingly, since 1997, although entry rates are not much lower than their time average, the contribution of entering firms to total export values has dramatically decreased. This points to a predominance of small exporters/firms among new entrants, which in turn might reflect two facts: the long history of increasing openness of the Italian economy and the 1992-95 depreciations which fostered a thorough internationalization among medium and large firms.

3. The theoretical model

Our theoretical model is taken from Roberts and Tybout (1997). We present it here starting from a firm's static problem of export participation with no sunk costs of entry and exit and then introducing a more general multiperiod structure with sunk costs. Finally, we extend it to analyze a more general timing in the acquisition of the assets requiring sunk costs.

Let us define by $\pi_{i,t}$ firm i's profits from exporting at time t. Assuming zero entry and exit costs and indicating with $q^*_{i,t}$ the profit maximizing level of exports, the foreign market participation problem of firm i at time t is as follows

$$\max_{y_{i,t}\in\{0,1\}} \pi_{i,t} \equiv [p_{i,t}(q^*_{i,t}, X_t, Z_{i,t})q^*_{i,t} - c_{i,t}(X_t, Z_{i,t}|q^*_{i,t})]y_{i,t} \tag{1}$$

where $y_{i,t} = 1$ if firm i exports a positive amount at time t and 0 otherwise, $p_{i,t}$ is the price of firm i's output on foreign markets in domestic currency, which is likely to depend on the quantity $q^*_{i,t}$, on aggregate factors X_t (exchange rate and world demand, above all) and on various firm characteristics[8] summarized by the vector $Z_{i,t}$. Reasonably, the same variables also influence the cost $c_{i,t}$. It is worth highlighting that equation (1) refers to the extra profits from exporting, i.e., in excess of those made on the domestic market, and neglects the exported quantity decision problem by setting $q_{i,t}$ to its optimal level. The optimal strategy $y^*_{i,t}$ is easily derived:

$$y^*_{i,t} = \begin{Bmatrix} 1 & \text{if} & \pi_{i,t} \geq 0 \\ 0 & \text{if} & \pi_{i,t} < 0 \end{Bmatrix} \tag{2}$$

i.e., firm i exports if extra profits from exporting are non negative. In a multiperiod context, the problem generalizes to

$$\max_{\{y_{i,\tau}\}_{\tau=t}^{\infty}} \Pi_{i,t} = E_t \left(\sum_{\tau=t}^{\infty} \delta^{\tau-t}\, \pi_{i,\tau} \right) \tag{3}$$

where δ is the one-period discount factor. If current revenues and costs do not depend on past choices, then the firm is called to maximize a sequence of static problems like (1) and the solution is again (2).

One interesting case in which this condition of "intertemporal independence" does not hold is when firms must pay entry (and exit) costs that are partially sunk. In this case, the

[8] These characteristics impact on prices through costs, product quality, efficacy of distribution and marketing policies, etc.

participation problem differs if the firm has paid such costs in the past or not. As a result, an entering firm must take into account foreign market future conditions; an exiting one must consider that its current decision will heavily affect future profits by entailing sunk costs in the case of re-entry into foreign markets. When we explicitly include these costs, per period profits from exporting become

$$\widetilde{\pi}_{i,t}\,(y_{i,t-1}) = y_{i,t}\left[\pi_{i,t} - (1 - y_{i,t-1})K\right] - (1 - y_{i,t})y_{i,t-1}F \tag{4}$$

where $y_{i,t-1}$ defines firm i's state (exporter versus non exporter) at the beginning of period t, K is the level of (sunk) entry costs and F is the one of (sunk) exit costs. The Bellman equation for this problem is as follows

$$V_{i,t}(y_{i,t-1}) = \max_{y_{i,t}\in\{0,1\}} \widetilde{\pi}_{i,t}\,(y_{i,t-1}) + \delta E_t\left(V_{i,t+1}(y_{i,t})\right) \tag{5}$$

and the optimal strategy turns out to be equal to

$$y^*_{i,t} = \begin{Bmatrix} 1 \text{ if } \pi_{i,t} + \delta E_t\left(V_{i,t+1}(1)\right) - (1 - y_{i,t-1})K \geq 0 + \delta E_t\left(V_{i,t+1}(0)\right) - y_{i,t-1}F \\ 0 \text{ if } \pi_{i,t} + \delta E_t\left(V_{i,t+1}(1)\right) - (1 - y_{i,t-1})K < 0 + \delta E_t\left(V_{i,t+1}(0)\right) - y_{i,t-1}F \end{Bmatrix}$$

or equivalently

$$y^*_{i,t} = \begin{Bmatrix} 1 & \text{if } \pi_{i,t} + \delta A - K + (K + F)y_{i,t-1}) \geq 0 \\ 0 & \text{if } \pi_{i,t} + \delta A - K + (K + F)y_{i,t-1}) < 0 \end{Bmatrix} \tag{6}$$

where $A = [E_t\left(V_{i,t+1}(y_{i,t} = 1)\right) - E_t\left(V_{i,t+1}(y_{i,t} = 0)\right)]$.

The structural estimation of this model would entail choosing a specific functional form for the profit function and a particular process for the exogenous aggregate variable. We choose instead the following reduced-form specification

$$\Pr(y_{i,t} = 1) = \Phi(\alpha_0, \beta y_{i,t-1}, \gamma X_t, \phi Z_{i,t-1}, \epsilon_{i,t}) \tag{7}$$

where α_0 is a constant term, $Z_{i,t-1}$ is lagged to avoid obvious endogeneity problems and $\epsilon_{i,t}$ is a random component. A positive and significant β would prove the existence of sunk costs. More precisely, as a proxy for $(K + F)$ it measures the width of the inaction band where firms neither enter nor abandon foreign markets[9]. It is worth recalling that here sunk costs are

[9] In a diagram with export market profitability on the vertical axis and time on the horizontal one, the upper band above which firms enter the foreign market is increasing in K; the lower band below which incumbent firms abandon the market is decreasing in F.

captured through persistence in a firm's behavior; the idea is that firms with past experience in foreign markets are more likely to be exporters today than those without that experience (state dependence), *ceteris paribus.*

Equation (7) identifies a binary choice model that we estimate using a Probit specification, i.e., $\Phi(.)$ is assumed to be the standard normal distribution.

The model as specified above embeds some strong simplifications. First of all, K and F do not vary across firms. This is highly implausible: the level of sunk costs must differ according to the type of product - that may require different marketing strategies and distribution policies - to firm characteristics - size, location, relative importance of exports in terms of total sales - and to foreign market features - large versus small, developed versus developing. In the empirical analysis, we relax this assumption allowing variability across firm size and level of exports. Secondly, equation (7) presumes that what matters is only last year participation: in relaxing this assumption, we also amend the theoretical model (see Appendix A for details).

4. The estimation strategy

The estimation of equation (7) raises a number of issues. The most important is the classical omitted variable problem caused by unobserved firm characteristics. The likely correlation between unobservables and regressors results in inconsistent estimates of the coefficients of the latter.

In our case, the problem is even more serious. To the extent that unobserved factors are time invariant and therefore sources of persistence, they will be picked up by the coefficient of the lagged dependent variable that would then be overestimated. This is what Heckman (1981a) calls "spurious state dependence" problem. Notationally, this problem can be represented by decomposing the residual $\epsilon_{i,t}$ into two pieces:

(8) $$\epsilon_{i,t} = v_i + u_{i,t}$$

where v_i denotes time invariant firm-specific unobserved characteristics and $u_{i,t}$ is the truly random component.

How do we deal with this? One strategy would be to control for as many firm characteristics as possible to empty v_i of any significance in the estimate: it is quite intuitive that this strategy finds an obvious limit in the content of the dataset. Therefore an alternative, usually feasible in panel data estimation, is the within estimator that explicitly accounts for unobserved factors through firm level fixed effects. Unfortunately, we can not pursue this because of the "incidental parameters problem". As argued by Heckman (1981b), the use of fixed effects in probit and logit models provides inconsistent estimates if the number of firms/individuals is very large, as in our case. This inconsistency becomes even more serious in dynamic models.

We therefore follow a different strategy which has been proposed by Chamberlain (1984) and recently implemented by Arulampalam et al. (1998) and Henley (2001). Chamberlain's solution simply amounts to adding a regressor proxying for unobserved heterogeneity which is correlated with observables; in our case, this new regressor is the vector of the observable characteristic means, i.e.,

$$v_i = a_0 + a_1' \bar{Z}_i + \xi_i \tag{9}$$

where now ξ_i is by construction orthogonal to $Z_{i,t}$ for any i and any t[10].

In conclusion, we solve the omitted variable problem of equation (7) substituting $\epsilon_{i,t}$ with equations (8) and (9) to get[11]

$$\Pr(y_{i,t} = 1) = \Phi(\alpha_0', \beta y_{i,t-1}, \gamma X_t, \theta Z_{i,t-1}, a_1' \bar{Z}_i, \xi_i, u_{i,t}) \tag{10}$$

The estimation of dynamic models like ours faces another serious difficulty, known as the "initial conditions problem" (Heckman, 1981b). This concerns the exporting status of a firm in its first year of observation, i.e., $y_{i,0}$ which is not very likely to be the firm's first year

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10 In other words, ξ_i is that part of unobserved heterogeneity that is not correlated with observed firm characteristics. It must be also noticed that, given the orthogonality between v_i and $u_{i,t}$, ξ_i is also orthogonal to $u_{i,t}$.

11 $\alpha_0' = \alpha_0 + a_0$

of existence[12]. For obvious reasons, this observation is not modelled when estimating equation (10) since the sample does not provide the lagged status and the other lagged controls. One important consequence is that $y_{i,0}$ is correlated with $\xi_{i,0}$ so that the estimate of β is inconsistent. More seriously, if unobserved factors are positively related to the probability of exporting, then β is overestimated so as to spuriously conclude in favor of high sunk costs. To account for this problem we again follow Heckman (1981b) who suggests estimating a reduced form equation to model the first year observation:

$$\text{(11)} \qquad \Pr(y_{i,0} = 1) = \Phi(b, \gamma X_0, \theta Z_{i,0}, a_1' Z_i, \eta_i)$$

where we again include the vector of means to control for unobserved heterogeneity. Evidently, equation (11) differs from equation (10) only because it lacks the lagged dependent variable.

Here we follow Orme (1999) and tackle the two equations (10 and 11) model in two steps[13]: in the spirit of Heckman selection bias procedure, we first estimate the presample equation (11) using the first three observations of each firm, then we plug the estimated residuals $\hat{\eta}$ in equation (10) to get

$$\text{(12)} \qquad \Pr(y_{i,t} = 1) = \Phi(\alpha_0', \beta y_{i,t-1}, \gamma X_t, \theta Z_{i,t}, a_1' \bar{Z}_i, \delta \hat{\eta}_i, \omega_i, u_{i,t})$$

with the idea that $\hat{\eta}_i$ proxies for that part of unobserved heterogeneity which is correlated with $y_{i,0}$ so that ω_i is at the end the remaining unobserved heterogeneity that is now orthogonal both to the lagged dependent variable and to the other firm-specific regressors.

Finally, we follow Roberts and Tybout (1997) and assume that $u_{i,t}$ has a first-order autoregressive structure, $u_{i,t} = \rho u_{i,t-1} + \tau_{i,t}$, which aims to account for the persistence that may derive from transitory shocks. Now it is $\tau_{i,t}$ to be independently and identically distributed.

We estimate both equations (11) and (12) with a random effect probit model.

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[12] More elegantly, Arulampalam et al. (1998) write: "...the start of the observation period does not coincide with the start of the stochastic process generating [exporting] experience."

[13] It must be said that this simplifying two-step estimation procedure would be a good approximation of a more complete model only if the correlation between η_i and ξ_i is small. However, Arulampalam (1998) has shown that the procedure provides acceptable results in a wider variety of cases.

With this specification, we slightly innovate with respet to the existing literature. Roberts and Tybout (1997) and Campa (2000), who estimate a random effects probit model with initial conditions, do not introduce the vector of means to control for unobserved heterogeneity: our results will show instead that it is an important correction. Bernard and Wagner (1998) and Bernard and Jensen (2001) also choose not to implement the presample estimation[14].

5. The results

The results from the estimation of equation (12) are shown in Table 6[15]. In column [1] they refer to a simpler specification not including firm-specific regressors, the vector of their means and the correction for the initial conditions[16] but only three macroeconomic variables[17]. The Italian real effective exchange rate based on domestic production prices ($REER$), a measure of Italian products price competitiveness on international markets, has the expected effect: the probability of exporting is higher in years of real depreciation of the domestic currency (increase of the index). WT, which indexes world trade conditions, has also a positive sign since firms are more likely export when facing higher external demand. Finally, the negative effect of domestic demand (DD) suggests that Italian firms sell abroad especially when demand is scant in Italy; surprisingly, the coefficient of DD is, in absolute terms, larger than the (positive) one of foreign demand, indicating that foreign market participation is more reactive to domestic than to external conditions[18]. With this specification, sunk costs seem to be quite important: from the coefficient of y_{t-1}, past experience makes current exporting an almost certain activity (the marginal effect, which is reported in curly brackets, is about .90).

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[14] They do not estimate a Probit model but a linear probability one without any individual effect, then in levels with fixed effects, finally in differences.

[15] The drop in the number of observations (from 270,000 to 160,000) is due to the combined effect of the presample model, using 85,000 observations, and the lagged depedent variable, y_{t-1}, excluding firms observed for less than two consecutive years.

[16] Obviously, we will appreciate their contribution by including them in the regression one at a time.

[17] In our view, these three variables provide a more interesting description of the effects of the macroeconomic environment on export participation than what can be inferred in other papers: Roberts and Tybout (1997), Bernard and Wagner (1998) and Bernard and Jensen (2001) use time dummies; Campa (2000) looks at the effect of the exchange rate but does not control for foreign and domestic demand.

[18] Speculatively, this might be due to the small size and therefore the low internazionalization of the average Italian manufacturing firm.

In column [2] we appreciate the impact of the presample estimation, which is reported in Appendix 1. The correction term (res) has a strongly significant coefficient ($t - statistic$ 22.49), signalling that we had an initial conditions problem in column [1]. As a result, the marginal effect of y_{t-1} drops to .819 from .866, but remains quite high and significant.

We then introduce sector and location dummies[19], and a wide set of firm-specific variables (column [3]), whose effect is, expectedly, to significantly reduce persistence in y_{t-1}: the marginal effect of export experience reduces by 10 per cent to .74.

The control for firm size is needed for various reasons: Krugman (1984) argues that firms may decide to export part of their production in order to exploit scale economies[20]; often size is interpreted as a proxy for a firm's success and efficiency. Indeed, we find that the coefficient of $size$ (which is the logarithm of the number of employees) is positive and strongly significant[21]. Firm age (age), often used to proxy for firm efficiency[22], does not play any role in our model[23]. Typically, exporting activity is for productive and cost-competitive firms[24]. We therefore include labor productivity ($ywork$ is the log of the value added per worker at 1995 constant prices) and average wage ($wage$ is the log of the ratio between total labor costs, at 1995 constant prices, and the number of employees), which have the expected sign, positive for productivity and negative for wage. It is worth mentioning that $wage$ measures cost and price competitiveness in that we explicitly control for firm productivity: interestingly, if we drop

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19 See Table 3 for details.

20 As argued by Basevi (1970), it might be that a firm sells abroad even at a lower price than the average total cost just to exploit the overall cost reduction deriving from the expansion of production.

21 The positive relationship between firm size and propensity to export has already found vast empirical support: among others, Bernard and Jensen (1998) find that US exporters display ex ante faster sales and employment growth than non-exporters; Ferragina and Quintieri (2001) show that Italian exporting firms are *ex ante* larger.

22 Tybout (1996) for Chile and Roberts (1996) for Colombia find that the probability of failure declines with plant age. According to Liu and Tybout (1996), failing Colombian firms are always less productive than surviving ones. For the US, the same patterns are found by Dunne et al. (1989). The underlying idea is that market forces select out inefficient producers so that older firms are more efficient and therefore more competitive in world markets.

23 Relying on previous evidence for Italian manufacturing firms (Bugamelli et al., 2000), we allow for a non linear relationship between age and probability of exporting.

24 Among the others, Bernard and Wagner (1997) show that highly productive German firms are more likely to become exporters. For some developing countries, Clerides et al. (1998) find that this probability is greater in low cost firms. Ferragina and Quintieri (2001) conclude that Italian exporters are more human capital intensive, technologically more advanced, more productive and with lower unit labor costs.

$ywork$, the coefficient of $wage$ becomes marginally positive in that more productive firms also pay higher salaries. The variable $market$, given by the ratio of marketing, distribution and advertising expenses to sales, aims to measure the degree of firm (or, better, product) visibility and, somehow, the quality of customer services: it turns out to have a significantly positive effect on the probability of exporting.

A different feature of a firm's location is captured by the dummy $distr$ that identifies whether a firm belongs to an industrial district[25]. The positive role of industrial districts for the Italian economy is well documented[26]: here we find that district firms are indeed more likely to become exporters. This result deserves particular attention in the light of two considerations. Given the sectoral dummies, the higher than average export propensity of district firms is not the result of their specialization in sectors of Italian comparative advantage (textiles and clothing, leather and leather products, furniture, etc.); rather, a positive network externalities is at work within districts. Moreover, these externalities benefit small and medium size firms that, as just shown, face major difficulties in exporting. Finally and not surprisingly, firms belonging to industrial groups (in this case, the dummy variable $group$ is equal to 1) find it easier to export part of their production.

In column [4] we also introduce the percentage of sales that a firm makes on foreign markets ($xsales$). Intuitively, the higher it is, the more likely it is that a firm will not abandon foreign markets, irrespective of sunk costs of exporting. The persistence induced by a high $xsales$ has more to do with sunk costs of establishing the firm itself than with sunk costs of exporting; for such firms leaving foreign markets is somehow equivalent to an economic failure or to a significant (and costly) reorganization of activity (for example, through a reduction of employment and other inputs)[27]. Its coefficient is significantly positive and helps to further reduce the coefficient of y_{t-1} whose marginal effect goes down to .725.

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[25] According to the Italian National Statistical Institute (Istat), a district is identified as a local labor system which is a territorial grouping of municipalities where there is a certain degree of commuting by the resident population, a high concentration of small and medium size firms belonging to the same two-digit sector. To construct our dummy variable, we have merged our dataset with the Industrial District Database constructed by Istat.

[26] Signorini (2000) offers a thourough and critical discussion and reviews a wide set of empirical works.

[27] It can be argued that $xsales$ also serves as a proxy for unobserved characteristics that are strongly relevant for exporting activity (e.g., managers speak English).

In the last column of the table we add the control for unobserved heterogeneity, i.e., the vector of means of the regressors as suggested by Chamberlain (1984). More precisely, we include all the time-varying firm specific regressors with the exception of the percentage of exported sales, which, in the long run, is evidently endogenous to the participation decision. Importantly, most of the coefficients of the lagged regressors remain significant, though definitely smaller. This correction turns out to be important: the marginal effect of y_{t-1} is now .70[28].

The sectoral and location dummies deserve a final comment. Despite the wide set of firm level controls, international specialization still matters. The probability of exporting is significantly larger for textiles, apparel, leather and leather products, industrial and commercial machinery, furniture and fixtures. Firms located in the South and, to a lesser extent, in the central part of Italy lag behind; this could reflect both their smaller degree of industrial development and their bigger distance from the main destination markets (e.g., EU countries).

The model performs quite well. Comparing the actual exporting frequencies and the predicted probabilities for past exporters ($y_{t-1} = 1$) and past non-exporters ($y_{t-1} = 0$), the differences are minimal (see Table 7).

A nice and succinct way to assess the importance of export experience relative to the other regressors (both firm-specific and aggregate) is provided in Table 8. The percentiles refer to the distribution of firms in terms of predicted probabilities of exporting computed using the estimated coefficients for all the variables except y_{t-1}[29]; these probabilities were then computed separately for firms with and without export experience.

Two results clearly emerge. Export experience matters much more than the other regressors: the increase in the predicted probability due to experience ranges from 68 to 71 percentage points; it is slightly larger for firms in the higher percentiles. Passing from the 25th

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28 Not surprisingly, the interaction between y_{t-1} and the macroeconomic variables signals that persistence is much stronger when external conditions are relatively better. This means that the difference between the "persistence in" and the entry rates in good periods is larger than the difference between the "persistence out" and the exit rates in bad periods. Speculatively, we might conclude that entry costs are more relevant than exit costs.

29 These predicted probabilities are: $\hat{\Xi} = \hat{\alpha}_0' + \hat{\gamma} X_t + \hat{\theta} Z_{i,t} + \hat{a}_1' Z_i + \hat{\delta}\hat{\eta}_i$

to the 75th percentile has an impact in terms of probability which is on average smaller than 10 percentage points. Although it is larger in absolute terms for firms already exporting, it is more significant in relative terms for firms still out of foreign markets whose predicted probability increases by almost 50 per cent.

5.1 *Robustness*

Our results are robust to various changes in the dataset and the empirical specification.

Up to now we have kept in the dataset all firms with reasonable figures so as to maximize the dimension of the working sample. However, this does not exclude the risk that some firms with very peculiar characteristics/behavior may drive the results, such as firms that have been in the sample for less than three consecutive years[30]. Since persistence of a firm's behavior is more likely over short than long periods, these firms may display an artificially higher than average persistence and so induce an upward bias in the coefficient of y_{t-1}. A similar overestimation can, in theory, be induced by firms intermittently appearing and disappearing from the sample. Given the dataset's bias toward better firms, these "marginal" firms may appear in periods of good performance when they also export and disappear in bad periods when instead they make zero sales on foreign markets. This in-and-out of the export market that would reduce overall persistence is *de facto* not considered in our estimation. We have therefore excluded these firms and re-estimated the last specification (column [6] of Table 6) obtaining, in both cases, the same results.

Small exporters can instead cause an underestimation of β. The reason is quite intuitive. Firms can export very small amounts without getting any real access to foreign markets but simply matching demand from an importer that has its own distribution network. Indeed, excluding firms that exported less than 200,000 euros in a year raises the coefficient of the lagged dependent variable slightly to 2.07.

One can argue that an AR(1) structure of the error does not capture all the persistence that may derive from transitory exogenous shocks. We have therefore extended it to an AR(2) without recording any difference in the results. The same happened adding more lags of the firm-specific regressors.

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[30] In the specification with just one lag of the dependent variable they are not necessarily dropped by the estimation procedure.

Finally, we have increased the disaggregation of the location (96 provinces instead of four macro-areas) and sectoral (4 instead of 2 digits) dummies to control for fixed effects that might be strong at the local and/or product level. Again we register no relevant changes.

6. Timing

So far we have assumed a very simplified structure for export experience: firms that exported two or three years earlier should behave as firms that have never exported; exporters' behavior does not differ with the number of years a firm has been present on foreign markets. In other words, the model above implies that all the assets whose acquisition entails sunk costs depreciate completely after one period and must be acquired immediately upon entry.

The objective of this section is to relax these assumptions and allow for a smaller depreciation rate, which is particularly reasonable if sunk costs have to do with knowledge and reputation, and for the spread of acquisition over some periods.

Depreciation is detected through the estimation of equation (1) where we add dummy variables to capture the number of years a firm has been out of foreign markets. The interpretation of the coefficients is identical to that of y_{t-1}: a positive and significant coefficient for Y_{t-j} says that a firm that exported last time j years ago is more persistent than one that has never exported or did so more than j years ago: this is to say that in the event of re-entry this firm has to acquire only a fraction of the assets needed for export. We would also expect the coefficient of Y_{t-j} to be decreasing in j as a signal that some depreciation occurs notwithstanding.

In Table 9 we report only the coefficients of export experience: the estimated coefficients for all the regressors included in column [6] of Table 6 are unchanged. The coefficient of the second lag (Y_{t-2}) is strongly significant and positive: firms that exported two years ago have a higher probability of exporting today than firms that have never exported. However, the fact that the coefficient of Y_{t-2} is significantly smaller than that of y_{t-1} signals that some depreciation is at work: in terms of marginal effects, it ranges from .70 to .20. When adding the third lag, this evidence is fully confirmed[31]. We also found (but not do report here) that

[31] The addition of more lags makes y_{t-1} more capable of measuring the differential persistence between exporters and firms that have never exported since persistence of firms that ceased exporting just few years before

the coefficient of Y_{t-j} dies out at $j = 6$, which indicates significant overall effects of export experience.

We then tackle the problem of how assets for exporting activity are acquired during a firm's export experience. In column [3] we estimate equation (1) and include one lag that aims to single out (from the mass of firms exporting at $t-1$) firms that did not export between[32] $t-6$ and $t-2$. The coefficient of S_{t-1} is not significantly different from zero. The evidence that sunk costs must be fully paid in the entry period is confirmed in columns [4] and [5] where exporters with two and three years of experience respectively are identified.

The combination of these two results suggests that persistence in foreign market participation could have very long-lasting effects that are also very strong right from the beginning. In a sense, this evidence suggests that the structural change that occurred in the Italian aggregate export function after the lira depreciations of 1992 and 1995 should be still there: owing to the strong and prolonged persistence subsequent reappreciations (particularly, in 1996) should not have had too big an impact on the aggregate function.

7. Size

So far we have imposed a unique sunk costs coefficient on all firms, which is admittedly a quite strong assumption. In this section we relax it, distinguishing firms according to their size. In doing so, we can also test the relative importance of two hypotheses, one proposed by Caves (1989), the other by Tybout (2001).

If sunk costs relate to information acquisition, organizational matters and similar things, Caves (1989) argues they should come in an almost fixed amount irrespective of firm size. As a consequence, small firms would encounter relatively higher barriers to entry into foreign markets[33]. Similarly, large firms can more easily adjust to fluctuations in export market profitability through entry and exit.

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t is now captured by Y_{t-j}. As a result, the coefficient of y_{t-1} grows.

[32] The choice of $t-6$ is related to our previous result.

[33] The result is qualitatively the same if sunk costs are an increasing but concave function of firm size.

Caves's hypothesis can be tested against the (not necessarily) alternative view proposed by Tybout (2001), which argues that what matters is not firm size but the size of exports. His idea is that firms value the level of sunk costs of exporting in terms of the amount of sales they would help to generate in foreign markets.

Table 10 summarizes the results that are definitively in favor of Caves' s view[34]. While the interaction of lagged export participation with size of exports (measured as the yearly deviation from its sample mean) is not significant (column [1]), the one with firm size (again in deviation from its yearly mean) is highly significant (column [2]). The result holds when both terms are included (column [3]).

One might argue that size is simply a proxy for technology. Firms in sectors like textiles, clothing and leather are smaller because their production technologies do not entail increasing returns to scale. The same technologies, along with specific marketing and distribution policies, might also impose higher sunk costs of exporting: for example, it is widely accepted that traditional Italian products compete on international markets through their better quality, which might require more aggressive (and costly) marketing strategies.

In column [4] we add the interaction between y_{t-1} and the sectoral dummies to control for this alternative explanation. The results are clear-cut. Firm size really matters: its negative coefficient decreases in absolute terms by a negligible amount and remains highly significant. Moreover, the new interaction terms are to a large extent not different from zero, with the exception of leather and industrial and commercial machinery, where firms show a significantly lower (and also similar) degree of persistence.

8. Information

A natural question that arises when thinking of sunk costs of exporting is about their nature. It is commonly accepted that one important component of sunk costs is the acquisition of information on foreign market demand and various institutional aspects. In this section we show that information does indeed affect persistence in and out foreign markets and therefore, given our modeling strategy, requires firms to pay sunk entry costs. It is worth mentioning that

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[34] Again we work on the full model of column [6] in Table 6.

we simply testify that information collection issues have to do with sunk costs, but we are not capable of measuring their relative importance.

A way of detecting the importance of information is to separate firms according to the ease with which they overcome informational barriers, that gain importance the more expensive and/or inefficient the process of collecting, processing and storing information becomes. We conclude that information is important if firms facing ex ante lower barriers also had a smaller inaction band (i.e., a lower coefficient of y_{t-1}).

Informational barriers vary across firms through two main channels. One indirect channel is firms' exposure to information spillovers. Along the lines traced by the theoretical literature on social learning, there are two necessary conditions for an economic agent to learn from others' actions: a) sharing a similar decision problem (similarity); b) easily and readily observing such actions. Following Guiso and Schivardi (2000), the Italian industrial districts are an useful laboratory for detecting the relevance of information spillovers: they satisfy, by construction, condition a), while the requirement of firms' physical proximity can satisfactorily proxy condition b). We therefore interact the dummy variable $distr$ with the lagged dependent variable and find (column [1] of Table 11) that belonging to an industrial district does help reduce the relevance of sunk costs of exporting.

Firms in industrial district are, by definition, smaller than average. Thus, the industrial district dummy may combine the positive effect of informational spillovers with the negative one relating to firm size. To control for the latter and let the former emerge, we add the interaction between size and y_{t-1}. The result (column [3]) confirms our intuition.

Again one might argue that the industrial district dummy is in fact capturing some technological aspects rather than informational spillovers: we have seen that two important district sectors ("leather and leather products" and "industrial and commercial machinery") display less persistence than average. To wipe out any doubt, we explicitly take into account sectoral specificities of sunk costs, again through the interaction terms between y_{t-1} and the sectoral dummies. In column [3] we show that the informational spillover story still holds.

Firms may also differ as to their ability to directly collect, process and store information. A possible way of testing this hypothesis is to subdivide firms in terms of their endowment of information and communication technologies (ICT). Reasonably, firms that have made larger investments in these technologies are in principle better able to collect and process information of any kind or, alternatively, can do it at lower costs and more efficiently[35]. Unfortunately, we do not have data on ICT capital at firm level; we therefore return to sectoral information.

To this end, we use the sectoral ratio between ICT capital and value added as computed by Bugamelli and Pagano (2001) and identify the following ICT intensive sectors: “printing and publishing”, “rubber and plastics products”, “fabricated metal products”, “industrial and commercial machinery”, “computer and office equipment”, “measuring and controlling instruments”, “motor vehicles and other transportation equipment”. The dummy variable ICT is equal to 1 if a firm belongs to one of these sectors.

One consideration is worth making. The two groups we have created are satisfactorily balanced in terms of both their relative contribution to Italian manufacturing value added and their export propensity: we can therefore rule out the possibility that the results are driven by comparative advantage rather than by ICT intensity. To this end, it should also be noticed that while “industrial and commercial machinery” is considered ICT intensive, “leather and leather products” is not.

Again our estimation (column [4]) supports the hypothesis that information matters for sunk costs of exporting: the coefficient of $ICT * y_{t-1}$ is negative and highly significant ($t - statistics$ -12.16). The results hold without variation when the interaction with firm size is added to the regression (column [5]).

9. Concluding remarks

Owing to the large fluctuations in the lira exchange rate, many Italian manufacturing firms entered foreign markets during the 1990s and their contribution to aggregate exports has been considerable. The importance of sunk costs of exporting and their relatively slow depreciation rate also suggest that the Italian aggregate export supply function has changed dramatically and that this change will be fairly long-lasting.

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[35] It is widely acknowledged that the Internet revolution has the potential to reduce the degree of inequality among agents in terms of information collection: through Internet everybody can, in principle, learn about events occuring in any corner of the globe. This argument should apply even more strongly to firms: business-to-business and business-to-consumer activities identify new Internet-based and cheaper practices for getting in touch with suppliers and customers.

Despite that, entry into foreign markets is still an open issue in Italy, at least from a policy perspective. This is true in general terms, since in 2000 only 17.3 per cent of Italian manufacturing firms were exporters. However, it becomes particularly relevant in the case of small firms. Our result that sunk costs constitute a special barrier to export for smaller firms must be combined with the evidence that such firms represent a huge proportion of Italian manufacturing firms but have a very low export participation rate: whereas about 95 per cent of Italian manufacturing firms have fewer than 10 employees, not 3 per cent of them sold products abroad during 2000.

We have also shown that export promoting policies should take care of firms' informational needs, at least to some extent. Not surprisingly, this is what happens in reality: a large proportion of the export promoting measures currently in place in Italy - managed by various government institutions - aims to provide information on foreign countries, on business opportunities abroad and similar.

Appendices

A.1 **Extensions of the theoretical model**

In this appendix we describe how to modify the theoretical model to allow for a more general timing structure in the acquisition of the assets necessary to obtain access to foreign markets. Let us start with the depreciation issue. To this end, we modify equation (7) following Roberts and Tybout (1997). Identifying with K the sunk entry cost that must be paid by those firms that have never exported or did so only a long time ago, we introduce another set of dummies K^j where $j > 1$ indicates the number of years the firm has been out of the export market. Analytically, we write:

$$\widetilde{\pi}_{i,t}\,(y_{i,t-1}) = y_{i,t}\left[\pi_{i,t} - (1 - y_{i,t-1})K - \sum_{j=2}^{J}(K^j - K)Y_{i,t-j}\right] - (1 - y_{i,t})y_{i,t-1}F \quad \text{(A1)}$$

where $Y_{i,t-j} = y_{i,t-j} * \prod_{k=1}^{j-1}(1 - y_{i,t-k})$ is equal to 1 when a firm exported at $t - j$, exited at $t - j + 1$ and did not re-enter afterwards[36]: in that case, $(K^j - K)$ is added to K leaving a re-entry cost equal to K^j. In line with a positive depreciation rate, we would expect $K^2 \leq K^3 \leq ... \leq K^n \leq ... \leq K$. The equation we are going to estimate in this case is then the following:

$$\Pr(y_{i,t} = 1) = \Phi(\alpha_0, \beta y_{i,t-1}, \beta_2 Y_{i,t-2}, ...\beta_j Y_{i,t-j}, \gamma X_t, \theta Z_{i,t}, \epsilon_{i,t}) \quad \text{(A2)}$$

To distinguish, instead, the timing according to which firms acquire the assets upon entry, we identify with M^j the sunk cost paid at time t by a firm which entered j years before (after at least *n* periods out of foreign markets) and did not exit afterwards. The corresponding indicator function is as follows: $S_{i,t-j} = \prod_{p=1}^{j} y_{i,t-p} * \prod_{k=j+1}^{j+n}(1 - y_{i,t-k})$, so that

$$\widetilde{\pi}_{i,t}\,(y_{i,t-1}) = y_{i,t}\left[\pi_{i,t} - (1 - y_{i,t-1})K - \sum_{j=2}^{J} M^j S_{i,t-j}\right] - (1 - y_{i,t})y_{i,t-1}F \quad \text{(A3)}$$

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[36] Obviously, $Y_{i,t-j}$ is equal to zero in all the other cases.

The equation to be estimated becomes:

$$\Pr(y_{i,t}=1)=\Phi(\alpha_0,\beta y_{i,t-1},c_1 S_{i,t-1},c_2 S_{i,t-2},...c_j S_{i,t-j},\gamma X_t,\theta Z_{i,t},\epsilon_{i,t}) \qquad \text{(A4)}$$

A.2 **The regressors**

REER is the Italian real effective exchange rate (index; 1993=100) based on production prices

WT is world export volumes (index; 1993=100)

DD is internal demand at constant prices (index; 1993=100)

size is the log of the number of employees

age is the log of firm age

age^2 is the log of squared firm age

ywork is the log of (deflated) value added per employee

wage is the log of (deflated) average wage

market is marketing, advertising and distribution expenses over sales

xsales is the ratio of exported to total sales

distr is a dummy variable that is equal to 1 if a firm belongs to an industrial district

group is a dummy equal to 1 if the firm belongs to an industrial group

res is the residual of the presample model ("initial conditions")

A.3 **Initial conditions problem**

Following Heckman (1982), we estimate equation (11) over the first three years of observations for each firm. The results are reported in the following table[37]:

[37] This means that the estimation also includes a constant term, the vector of means of the time-varying regressors and the sectoral and location dummies (not reported here).

Presample estimation

$REER$	.002	$ywork$	.095
	(.001)		(.019)
WT	.002	$wage$	-.056
	(.001)		(.028)
DD	-.004	$market$	.965
	(.002)		(.184)
$size$	.149	$distr$	.051
	(.018)		(.008)
age	-.198	$group$	.062
	(.112)		(.015)
age^2	.088		
	(.051)		
No. obs.	85,309		
$Prob > \chi^2$	.000		

Notes: Random Effects Probit estimates, heteroskedasticity-robust standard errors in brackets. For a description of the regressors see also Appendix 1.

Tables

Table 1

Sample size and coverage

	1982	1983	1984	1985	1986	1987
SIZE						
number of firms in the sample	9,426	10,291	12,154	13,408	14,688	15,265
percentage of exporters	34.8	32.0	40.3	40.2	38.8	39.0
COVERAGE						
value added (% of total manuf.)	21.4	22.1	23.4	24.6	26.0	26.5
employees (% of total manuf.)	21.2	21.8	23.3	24.3	25.2	25.7
exports (% of total manuf.)	14.0	13.5	19.0	20.1	21.4	21.5
	1988	1989	1990	1991	1992	1993
SIZE						
number of firms in the sample	16,182	18,027	18,710	18,619	18,760	18,428
percentage of exporters	35.9	37.7	38.0	37.0	31.5	28.3
COVERAGE						
value added (% of total manuf.)	26.7	27.6	28.7	29.3	29.4	29.8
employees (% of total manuf.)	26.7	28.1	28.8	28.4	27.5	27.2
exports (% of total manuf.)	21.5	23.3	24.2	24.3	20.3	18.6
	1994	1995	1996	1997	1998	1999
SIZE						
number of firms in the sample	18,162	11,914	11,803	11,547	11,151	10,620
percentage of exporters	34.2	51.5	56.6	59.0	61.1	60.4
COVERAGE						
value added (% of total manuf.)	29.2	25.6	25.5	24.8	23.5	22.5
employees (% of total manuf.)	27.0	23.6	24.1	23.4	22.7	21.7
exports (% of total manuf.)	23.4	24.3	26.5	26.5	26.1	24.9

Table 2

Descriptive statistics

	full sample			subsample of exporters		
	1985	1990	1995	1985	1990	1995
sales	11,167	11,331	18,674	13,381	13,819	22,748
value added	3,065	2,984	4,847	3,752	3,651	6,015
employees	85	76	98	105	95	118
employees (median)	43	37	58	55	50	72
firm age	16	18	21	17	19	22
wage (per capita)	21.4	23.6	28.2	21.4	23.9	28.7
marketing expenses (% of sales)	3.1	3.4	0.7	3.5	3.9	1.0

Notes: Sample means. Sales, value added and wage are in thousands of 1995 euros.

Distribution of firms by sector and location

	1985		1990		1995	
	full sample	exporters	full sample	exporters	full sample	exporter
Food, beverages and tobacco	9.4	5.8	8.7	5.5	10.8	7.0
Textiles	10.2	12.0	9.5	11.3	10.7	12.2
Apparel and related products	4.1	5.2	4.1	5.1	3.8	4.2
Leather and leather products	4.4	6.8	4.7	7.0	5.0	5.4
Lumber and wood products	2.4	1.3	2.4	1.4	1.9	1.5
Paper and allied products	2.9	1.8	2.7	2.1	2.9	2.4
Printing and publishing	2.4	1.0	3.0	1.2	2.4	1.3
Petroleum refining and related ind.	0.1	0.1	0.2	0.1	0.3	0.2
Chemicals and allied products	6.1	5.3	5.6	4.9	6.0	6.1
Rubber and plastic products	5.7	5.9	5.7	5.6	5.9	6.2
Stone, clay, glass	7.8	5.5	7.2	5.6	6.1	4.7
Primary metal products	4.4	3.6	4.0	3.2	4.1	4.0
Fabricated metal products	10.2	9.0	10.6	9.4	9.6	9.6
Ind. and comm. machinery.	14.1	19.4	14.5	19.8	13.8	17.5
Computer and office equip.	0.3	0.2	0.4	0.3	0.2	0.2
Electrical equipment	4.0	4.0	4.5	4.2	4.3	4.3
Audio, video and comm. equip.	1.9	1.9	2.2	1.9	1.7	1.7
Measuring and controlling instr.	1.6	2.1	1.8	2.2	1.9	2.0
Motor vehicles	1.7	2.1	1.6	1.6	2.1	2.4
Other transportation equip.	1.2	1.1	1.1	1.1	1.0	0.8
Furniture, fixtures and misc.	5.4	6.0	5.7	6.7	5.5	6.5
Total	100	100	100	100	100	100
North West	44.7	49.3	44.1	47.2	44.1	48.3
North East	28.1	28.6	28.1	29.8	30.4	33.2
Centre	17.4	18.4	18.1	18.4	17.1	14.4
South	9.8	3.7	9.6	4.6	8.4	4.2
Total	100	100	100	100	100	100

Notes: Percentage values. Manufacturing sectors are classified according to Nace Rev.1 - two digits. The north-western part of Italy includes the following regions: Piemonte, Valle d'Aosta, Lombardy and Liguria. North East: Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia and Emilia-Romagna. Centre: Tuscany, Umbria, Marche and Lazio. South: Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily and Sardinia.

Table 4

Propensity to export by sector and firm size

	1985			1990			1995		
	a)	b)	c)	a)	b)	c)	a)	b)	c)
Food, bever. and tobacco	20.2	34.1	35.2	20.7	31.8	30.2	26.3	43.8	55.6
Textiles	45.2	47.7	64.5	42.2	47.0	66.2	55.0	59.1	84.0
Apparel and related products	46.1	54.3	55.9	42.6	50.5	67.4	48.4	62.9	71.8
Leather and leather products	56.9	68.7	80.0	50.6	67.7	69.2	45.9	66.8	92.8
Lumber and wood products	13.2	35.3	25.0	16.7	37.7	20.0	31.9	51.7	75.0
Paper and allied products	18.5	34.5	60.0	20.9	39.8	66.7	27.2	50.3	94.4
Printing and publishing	9.3	22.1	33.3	10.2	24.1	28.6	15.6	35.3	35.7
Petrol. refining and related	9.1	28.6	0.0	5.0	10.0	22.2	25.0	45.5	0.0
Chemicals and allied products	27.0	41.0	54.3	26.2	42.4	48.7	39.8	61.9	68.1
Rubber and plastic products	33.9	54.0	59.3	29.6	51.6	50.0	40.6	62.4	100.0
Stone, clay, glass	24.3	36.2	39.5	23.4	43.0	32.7	28.3	46.8	66.7
Primary metal products	23.0	42.5	58.5	20.6	40.2	45.7	35.8	60.7	72.0
Fabricated metal products	27.9	44.4	60.0	26.3	45.2	64.4	43.0	54.8	83.7
Ind. and comm.machinery	49.3	62.5	62.2	45.7	58.8	69.0	54.3	69.6	87.8
Computer and office equip.	11.1	35.3	50.0	20.0	33.3	62.5	27.8	50.0	83.3
Electrical equipment	33.7	45.3	48.9	30.0	43.9	34.4	37.4	59.3	71.7
Audio, video and com. equip.	36.7	41.7	50.0	26.0	45.2	39.4	25.8	63.0	51.6
Measur. and control instr.	48.6	53.6	72.7	40.0	52.7	65.2	39.0	56.6	80.8
Motor vehicles	36.9	51.7	68.4	32.1	39.3	55.0	52.9	56.4	71.1
Other transportation equip.	33.8	46.9	28.1	31.8	41.4	36.8	34.2	40.6	52.9
Furniture, fixtures and misc.	39.6	52.9	76.9	38.0	55.3	73.7	49.4	68.4	80.0
Total	33.6	47.8	54.7	31.7	47.2	51.8	40.4	58.6	75.2

Notes: Percentage values. a) firms with less than 50 employees; b) firms with 51 to 300 employees; c) firms with more than 300 employees.

Entry, exit and persistence

t	$t+1$	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91
No	No	90.2	78.7	86.0	86.8	86.0	87.8	82.1	86.8	89.2
	Yes	9.7	21.3	14.0	14.2	14.0	12.2	17.9	13.2	10.8
Yes	No	25.1	15.5	17.8	21.8	19.8	23.9	23.0	19.6	19.7
	Yes	74.9	84.5	82.2	78.2	80.2	76.1	77.0	80.4	80.3
change in $REER$		-3.0	-0.2	-1.1	6.1	3.4	2.4	2.1	4.2	-0.5
change in WT		2.5	8.3	3.4	4.3	6.3	8.9	7.0	5.6	4.6
change in DD		0.4	3.2	3.1	2.7	4.0	3.8	2.9	2.6	2.1
X_{t+1}	entry	13.6	28.7	13.4	14.6	13.0	13.6	21.6	13.6	12.2
X_t	exit	21.5	10.6	13.2	16.7	14.6	18.8	15.7	12.9	12.8

t	$t+1$	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99
No	No	90.2	82.8	80.7	74.8	77.7	82.0	84.1	87.2
	Yes	9.8	17.2	19.3	25.2	22.3	18.0	15.9	12.8
Yes	No	30.0	45.4	27.8	11.5	10.3	8.7	6.2	9.0
	Yes	70.0	54.6	72.2	88.5	89.7	91.3	93.8	91.0
change in $REER$		-2.3	-14.2	-2.0	-4.6	11.0	0.3	1.4	-2.8
change in WT		4.4	3.8	10.0	10.0	6.2	10.4	4.6	5.6
change in DD		0.5	-4.5	2.1	2.2	0.6	2.7	3.0	2.8
X_{t+1}	entry	11.6	31.7	33.8	19.7	11.8	8.5	5.9	4.9
X_t	exit	24.6	31.2	15.9	5.4	5.9	4.8	3.1	5.5

Notes: Percentage values. Yes and No refer, respectively, to being or not being an exporter. Therefore the sequences $No - Yes$ identifies entering firms, $Yes - No$ exiting firms, $Yes - Yes$ and $No - No$, respectively, the firms that stay in and out foreign markets. In the upper part of the Table, the entry, exit and persistence rates are provided. In the lower part X is the share over total exports due to entering and exiting firms. $REER$, WT and DD are described in Appendix 1.

Base regression

	[1]	[2]	[3]	[4]	[5]
y_{t-1}	2.397*	2.265*	2.045*	2.001*	1.939*
	(.009)	(.010)	(.010)	(.012)	(.012)
	{.866}	{.819}	{.740}	{.725}	{.702}
$REER_t$	.004*	.005*	.006*	.006*	.006*
	(.001)	(.001)	(.001)	(.001)	(.001)
WT_t	.013*	.014*	.014*	.013*	.013*
	(.001)	(.001)	(.001)	(.001)	(.001)
DD_t	-.033*	-.036*	-.035*	-.034*	-.033*
	(.002)	(.002)	(.002)	(.002)	(.002)
$size_{t-1}$			.168*	.166*	.076*
			(.005)	(.005)	(.018)
age_t			-.347	-.286	-.349
			(.366)	(.365)	(.367)
age_t^2			.156	.129	.157
			(.173)	(.173)	(.173)
$ywork_{t-1}$			.168*	.168*	.097*
			(.013)	(.013)	(.020)
$wage_{t-1}$			-.070**	-.071**	-.102**
			(.023)	(.023)	(.034)
$market_{t-1}$			1.065*	1.067*	-.252
			(.109)	(.108)	(.157)
$xsales_{t-1}$				.291*	.288*
				(.024)	(.023)
$distr$			.023*	.022*	.021*
			(.005)	(.005)	(.005)
$group$			.035*	.033*	.025**
			(.010)	(.010)	(.010)
res		.270*	.392*	.375*	.381*
		(.012)	(.011)	(.012)	(.012)
No. obs	162,283	159,214	159,214	159,214	159,214
$Prob > \chi^2$	.000	.000	.000	.000	.000

Notes: Random Effects Probit estimates of equation (12); heteroskedasticity-robust standard errors in brackets; marginal effects in curly brackets. The dependent variable is the current status (exporter vs non exporter); y_{t-1} is the status at $t-1$; for the other regressors see Appendix 1. All estimations include a constant term, from column [3] on they also include sectoral and location dummies (according to the classifications reported in Table 3). * identifies significance of the coefficient at 0.1 per cent; ** identifies significance at 1 per cent.

Table 7

Goodness of fit

	actual	predicted
$y_{t-1} = 0$	.154	.120 [.062]
$y_{t-1} = 1$	.815	.862 [.070]

Notes: Predicted probabilities from the estimation of the model in column [6] of Table 6. Standard errors are in square brackets.

Table 8

Export experience vs the other regressors

	25th pctile	50th pctile	75th pctile
$y_{t-1} = 0$	.141	.166	.205
$y_{t-1} = 1$	.823	.871	.915

Notes: Predicted probabilities from the estimation of the model in column [6] of Table 6. Percentiles refer to the distribution of firms according to the predicted probabilities computed using the estimated coefficients for all the variables except y_{t-1}.

Timing

	[1]	[2]	[3]	[4]	[5]
y_{t-1}	1.827*	1.926*	1.960*	1.958*	1.946*
	(.012)	(.013)	(.014)	(.014)	(.015)
Y_{t-2}	.516*	.564*			
	(.015)	(.016)			
Y_{t-3}		.455*			
		(.019)			
S_{t-1}			.033	.033	.041
			(.029)	(.029)	(.029)
S_{t-2}				.011	.015
				(.028)	(.028)
S_{t-3}					.016
					(.028)
No. obs	159,214	159,214	122,595	122,595	122,595
$Prob > \chi^2$	.000	.000	.000	.000	.000

Notes: Random Effects Probit estimates of equations (1) and (1); heteroskedasticity-robust standard errors in brackets. The dependent variable is the current status (exporter vs non exporter); y_{t-1} is the status at $t-1;$ the variable Y_{t-j} is a dummy that takes on value equal to 1 if a firm exported for the last time j years ago; the dummy S_{t-j} is equal to 1 if a firm started exporting at $t-j$: a detailed description can be found in Appendix A. All the estimations include all the regressors of the full model of column [6] in Table 6 (therefore including a constant term, sectoral and location dummies). * identifies significance of the coefficient at 0.1 per cent; ** identifies significance at 1 per cent.

Firm size and value of exports

	[1]	[2]	[3]	[4]
y_{t-1}	1.939*	1.946*	1.946*	2.026*
	(.012)	(.012)	(.012)	(.195)
$(dX * y)_{t-1}$	.001		.001	.001
	(.002)		(.003)	(.003)
$(dsize * y)_{t-1}$		-.057*	-.057*	-.054*
		(.009)	(.009)	(.009)
$size_{t-1}$	.076*	.102*	.102*	.100*
	(.018)	(.019)	(.019)	(.019)
No. obs	159,214	159,214	159,214	159,214
$Prob > \chi^2$	.000	.000	.000	.000

Notes: Random Effects Probit estimates; heteroskedasticity-robust standard errors in parenthesis. The dependent variable is the current status (exporter vs non exporter); y_{t-1} is the status at $t-1$; $dsize$ is the number of employees in deviation from the yearly (log) mean ; dX is the value of exports in deviation from the yearly (log) mean. All the estimations include all the regressors of the full model of column [6] in Table 6 (therefore including a constant term, sectoral and location dummies). * identifies significance of the coefficient at 0.1 per cent; ** identifies significance at 1 per cent.

Information

	[1]	[2]	[3]	[4]	[5]
y_{t-1}	1.963*	1.973*	2.035*	1.994*	1.999*
	(.015)	(.015)	(.195)	(.014)	(.014)
$(distr * y)_{t-1}$	-.026**	-.030**	-.025*		
	(.010)	(.010)	(.010)		
$(ICT * y)_{t-1}$				-.154*	-.149*
				(.018)	(.018)
$(dsize * y)_{t-1}$		-.059*	-.055*		-.054*
		(.009)	(.009)		(.009)
No. obs	159,214	159,214	159,214	159,214	159,214
$Prob > \chi^2$	.000	.000	.000	.000	.000

Notes: Random Effects Probit estimates; heteroskedasticity-robust standard errors in brackets. The dependent variable is the current status (exporters vs non exporter); y_{t-1} is the status at $t-1$; ICT is a dummy variable that takes on a value equal to 1 for the sectors where the use of information and communication technologies is higher than average: for the list of sectors see the text in Section 8. All the estimations include all the regressors of the full model of column [6] in Table 6 (therefore including a constant term, sectoral and location dummies). * identifies significance of the coefficient at 0.1 per cent; ** identifies significance at 1 per cent.

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